

AN EFFICIENT STRATEGY FOR DEVELOPMENT OF FLEXIBLE LEARNING MATERIAL

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ABSTRACT

In recent times there has been a proliferation of activity in the area of flexible learning for tertiary institutions [1], [2], [3]. Some of the reasons for this interest are that 1) students have more options as to when and how they will learn, 2) distance education is far more practical, 3) staff teaching time can be reduced substantially in the long term, and 4) the computer animation achievable through currently available multimedia tools can enable more effective learning of difficult concepts; etc.

Despite the potential benefits, the percentage of academic staff actively pursuing development of flexible delivery units in their courses is small. The reason for this reluctance is the seemingly daunting amount of effort required to produce the necessary multimedia tools. The time required to become proficient in multimedia packages is in itself a major deterrent. This paper describes one methodology for surprisingly efficient development of flexible delivery materials. The key to the methodology is to perform the development in a sequence of stages. The stages are designed so that useful products are available at the completion of all stages, even the first one. The approach has been trialed at RMIT with very encouraging success - class contact time has been substantially reduced and students are happy about the changes.

done in the first instance by a multimedia specialist. The academic can then check the result of the transfer. The third stage of the methodology involves the inclusion of automatic testing and interaction capabilities. It should be pointed out that this is an optional stage, for two reasons. Firstly, there is some natural resistance by students to new educational software tools [5, 8]. This is particularly so if the tool is highly interactive and requires significant time for students to become familiar with using it; consequently, there is some advantage to keeping the tool simple and non-interactive. Secondly, and more importantly, the development of this third stage is very time consuming, and the associated rewards may not be cost effective. Since this paper concerns the *efficient* development of multimedia tools, it may be best to use some of the time saved via flexible delivery to provide "help sessions". If pursued, this third stage can be jointly developed by the academic and the multimedia expert. This paper describes details of the abovementioned strategy, which was used for implementation and evaluation of flexible delivery material in the Signal Processing subjects in the Bachelor of Engineering degree provided by the Communication & Electronic Engineering Department at RMIT, Melbourne. These subjects include "Signals & Systems" (EL301, 3rd year) and "Digital Signal Processing" (CO451, 4th year). One of the key features of the strategy is the development of much of the flexible learning modules "on the fly", i.e. during the normal run of an academic's responsibilities.

1 INTRODUCTION

The first stage is to produce videos (both conventional and computer compressed versions) of the material. These can be produced "on the fly" (i.e. during the normal run of an academic's activities), without the academic being fully skilled in multimedia development. The results of this first stage can be used as flexible delivery units, and can give academics their first "taste of success", in terms of time saving, flexibility, etc. Experience has found that this success provides academics with motivation to do further flexible delivery development.

The second stage involves the systematic transfer of the video units to more space efficient multimedia packages, such as "Toolbook". Because this task is essentially a transfer of information, it does not require in depth knowledge of the technical content of the subject matter. Rather, it necessitates expertise in multimedia, and can be

2 STAGE 1 DEVELOPMENT

Recourse was made in the first instance to the conventional wisdom that there are three major components required for students to effectively learn in a subject. These three components are the "lectures", the "tutorials" and the "laboratories". Flexible learning modules were developed for each of these categories. The developed modules were based on what had been used in the traditional lectures/tutorials/laboratories over two or more years. Because the underlying technical content had been used in traditional delivery for some time, and a substantial amount of troubleshooting had already been done, there was a good degree of confidence that the flexible delivery units would be comparatively free of technical errors.

It was decided to provide two options in the provision of the flexible material. The first provision option was a suite of videos, and the second option was a corresponding suite of computer compressed video files (MPEGs). The video option was used so as to accommodate as wide a target audience as possible, since it was considered that almost all students would have ready access to a video player. The computer files option was provided for greater flexibility.

Once developed, the units were made readily accessible to students. One set of the videos was placed in the audio-visual section of the RMIT library, where students could listen to (but not borrow) them. Another set was placed at a borrowing point in the Comm. & Elec. Dept., with students being able to borrow the videos for one day, during which time they could copy the tapes. The computer files were placed on the departmental computer network, and on compact discs (CD)s. These CDs have also been made available to the students for a one day loan. Details on how these materials were created are given below.

2.1. Lecture material.

For the sake of efficiency, it was decided to develop the flexible mode lecture material as far as possible "on the fly". i.e. video recordings were made while the lecturer was delivering his scheduled lectures. In order to achieve this, solid preparation was required before lectures, as it is for all good teaching. Some additional technical apparatus had to be assembled also. The steps required for effective lecture taping are listed below.

(a) *Development of an automated transportable recording system.* To do any video recording it is obviously necessary to have a high quality camera. The recent advances in technology have seen the development of cheap high quality digital video cameras. One camera which can be used for the recording is a Panasonic DA1 model, which currently costs about \$1800 tax free.

(b) *Recording of the lectures.* If the video recording process was to be done during lectures, it had to be highly automated and introduce minimal disturbance to the normal flow of the lecture. Fortunately, as in many modern universities, the setup of the main departmental lecture theatres allowed for this possibility. These theatres provided projection from both a computer screen and from2.. a "document camera" (ie. an inbuilt video camera which focused on a flat screen, where the lecturer could write). The digital camera can be locked onto this projected screen for the duration of the lecture, with the lecturer using the remote controller to start and stop the recording. An external microphone can also be used to record the lecturer's voice. It is not crucial to capture the lecturer's face during the lecture, but if this is desired, one can often swivel the document camera to do this capturing. The recording described above could be (and almost invariably was) manned by a single person, making the recording process a highly efficient one.

(c) *Lecture preparation.* The fact that lectures were to be recorded created a strong incentive for thorough preparation. Many multimedia demonstrations were used,

similarly to the approach in [7]. All multimedia demonstrations were checked in advance, the outline of the lecture was carefully mapped out, and the way in which concepts would be explained were carefully thought through. One aspect which could not be predicted in advance was student questions, but these were generally handled adequately. One had simply to repeat the question before answering so that it could be clearly heard on the video tape.

2.2. Tutorials

The tutorials were again taped, as far as possible, "on the fly". During the tutorial the instructor worked through a number of set problems and wrote on a whiteboard to a student audience. Students were periodically given time to attempt parts of the problem themselves, although these gaps in time were not recorded. The camera was set up to record the proceedings, and the output was displayed real time on a large screen TV, to help monitor the recording process. The recording could be done in almost any room with a whiteboard and adequate lighting. Students asked questions as in a conventional tutorial and the answers were recorded. The author also used his experience to pose and answer a set of "frequently asked questions". These tutorials served as a way to help students to gain problem solving skills in signal processing. The students were also set additional problems to do entirely by themselves.

2.3. Laboratories.

These videos were made again "on the fly" (i.e. during scheduled lab times) in most instances. The video material began by explaining the theoretical concepts underpinning the experiment, and then proceeded to discuss some of the practical issues that students would need to address. The video material was also compressed into MPEG computer files, and then into more highly compressed REAL MEDIA files. In the 4th year and postgraduate laboratories, students could have the MPEG/REAL MEDIA files in a window in one corner of the screen and their computer based laboratory running in the rest of the screen. They could thus call up instruction via the computer video player as they found it necessary.

2.4. Conversion of the videos to MPEG files.

All the tutorial and laboratory video files needed to be digitised and compressed so that they could be viewed on computers. Computer viewing offers substantial advantages in that 1) the user can fast forward/reverse very quickly, and 2) they can be used in conjunction with computer laboratories. The digitisation and compression was achieved with a real-time MPEG card. The amount of data generated was enormous - approximately 18 Gbytes for the various tutorials and laboratories in the different subjects. Later, the RealProducer program was purchased and the files were compressed by a factor of 7, so that the total space needed dropped to less than 3Gbytes.

2.5. Evaluation.

Fully independent reviews were available from two key sources in the Dept. of Communication & Electronic Engineering. The first source was the regular sequence of student feedback meetings known as CQATs (Course Quality Assurance Teams). One extract of the minutes of the CQAT meetings was: "video tapes and tutorials using MPEG great help. Use of digital camera very handy for both lecturer and students (easy access)". In general, the comments about videos and MPEGs were very positive. The second source of reviews was a yearly end of year retreat at which students compile a report on all subjects.

The report on EL301 stated that: "The use of MPEG's and videos are an excellent resource for students to review relevant topics covered in the course, both at a tutorial and lecture level".

In the first semester in which the video tapes were placed in the library for EL301, the usage of the videos was carefully recorded. There were 4 tapes of the tutorials and these were viewed a total of 236 times. There were 5 tapes of the lectures, and these tapes were viewed a total of 70 times. This is a very high number considering that during that time, live lecture/tutorials were also available. Frequently, as well, several students were associated with the one viewing. Moreover the same material was also accessible from other sources (ie. via overnight loan from a departmental borrowing point, and in some cases, computer based MPEG files).

2.6.1. Benefits.

Since 1997 the lectures and laboratories in the signal processing subjects cited at the beginning of this report have been running in traditional mode, with the students having the option of doing them via flexible delivery. Since 1999 the tutorials have been running via flexible delivery mode, but with a limited number of help sessions where students can ask questions to clarify what they have not grasped.

The arrangement has provided advantages to the students in terms of flexibility as to when they can learn the material. It is currently providing benefits to academic staff in that there is less repetitive delivery. They only need address issues when students have questions. The saving in contact hours achieved through flexible delivery tutorials has been 4.5 hours per week.

The possibility exists, however, for all subjects to run entirely in flexible delivery mode. ie. without formal lectures, tutorials or laboratories. One student has already trialed this approach in EL301 in the second of two semesters, and his feedback was that he found the experience a highly positive one; he had no negative comments to make. His performance relative to the rest of the class improved when he undertook flexible learning. The feedback and performance of just one person can not be used to yield statistically significant conclusions. Nonetheless, at this stage, the prospect of fully flexible delivery looks promising. Further testing is planned to see if the findings in [4] hold. i.e. that if the course material is well designed, students find the experience satisfying and

learn well. The lecturer hours/week that could be saved through "direct replacement" of the lecturer is very substantial - 2.75 lecture contact hours, 4 tutorial contact hours, and 5 laboratory contact hours.

What is particularly noteworthy about this is that it has been achieved with a comparatively small time investment and (thus far) with enthusiastic student support. It has been achieved with the products of just the first stage of development.

3 STAGE 2&3 DEVELOPMENT

The transfer of information from the videos to the multimedia format can be done in a relatively straightforward manner. Some simple rules of thumb can be used. For example, the academics words are transferred (as text and audio), but obvious redundancies (such as utterances of um, ah, ok, etc. should be removed). Diagrammatic explanations should generally be transferred substantially as they are, although to appear in a much more neat form. The multimedia expert may also use some discretion to include some animation in the diagrams.

3.1. Automatic Testing.

The tests can be provided by the academic, and it is possible that they may be based on tests used in conventional subject delivery over a number of years. The questions, however, are likely to need reformatting so that the answers can be readily corrected by a computer. The advantages of this stage are that the lecturer saves significant time in marking, and students receive feedback at various stages of the year.

3.2. Insertion of interactive capabilities .

The incorporation of interactive capabilities is one of the most time consuming tasks. It is deliberately left as the final stage so that the academic has (hopefully) enjoyed the benefits of having completed prior stages, and has thus acquired sufficient motivation. It is inappropriate here to detail the many nuances of developing interactive educational tools; they are documented elsewhere (eg. [6]). It is simply stated that the material developed in the first stage is used as the basis for the development. At RMIT, interactive features have not yet been completed.

4 CONCLUSIONS

The use of a stage by stage approach to creation of flexible delivery materials has been found to be very efficient. Significant time-savings can be achieved after completion of only the first stage, and these time-savings can be used to implement further stages. The strategy has been partially implemented in the Dept. of Communication & Electronic Engineering at RMIT, and surprisingly, there has been wholehearted student support for it.

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